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PROTECTION OF WATER SUPPLIES BY SEWAGE PURIFICATION[1]

By Harry B. Hommon[2]

One of the most important questions confronting many of our cities today is that of securing and maintaining a water supply that is free from pathogenic organisms and otherwise suitable for domestic and industrial purposes. As our cities grow in size and increase in number, the problem becomes more complex for the reason that the water-courses of the country are used, on one hand, as a source of domestic supply, and on the other, as a means of sewage disposal. It is common practice for a city to take its water from a river at the upstream side and discharge it below the city as sewage. This dual use of a water-course has been accepted and recognized by the courts as coming within the rights of the riparian proprietor, but only in so far as the privileges claimed do not conflict with similar rights of others located on the same body of water.

It is not always an easy matter, however, to decide where the rights of one party end and the lawful privileges of another begin. In the past, and to a certain extent at the present time, courts have been called upon to decided controversies arising from the use of streams as a means of disposing of sewage and other wastes. More recently many states have passed laws to regulate stream pollution and the results have been so satisfactory that it is believed that within a few years all the states will have laws on their statute books which will permit active control over the purity of the water-courses in the country within the boundaries of the states.

One of the most important results that has come from the court decisions handed down and the state laws that have been passed in relation to stream pollution, has been the treatment of sewage as a means of protecting water supplies. It may be of interest in this connection to quote the fundamental principles given by Montgomery and Phelps,[3] which the courts have recognized as the basis for their decisions.

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[1] Read before the Illinois Section, March 24, 1920. Discussions of this paper are requested and should be sent to the Editor.

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> The basic rule in common law has been stated to be that each riparian proprietor has the right to have the stream come down to him with its quality unimpaired and with its quantity undiminished.
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> But expressions like the above are extreme statements of the rule and cannot be accepted literally.
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> That is to say, each riparian proprietor is interested on the one hand, in having the water come down to him in its natural state and in its full volume. On the other hand, he is interested in making the largest use of the stream which his convenience or interest may dictate; and since almost any use of the stream has some tendency either to diminish the volume or lessen its purity, or both, it follows that a rule which would preclude each riparian owner from polluting the stream at all or from diminishing its volume at all would defeat its own purpose; and this has been recognized by the courts.

Quoting further from the report referred to above, it is shown that municipalities have no further rights than individuals.

> By the great weight of authority, municipalities have not greater rights than individuals to pollute water-courses and must respond in damages for any injury caused to a lower riparian proprietor and may be enjoined continuing the pollution.

It is thus seen that the courts have recognized the right of an individual, corporation, or city to use a water-course as a means of carrying off its sewage, but only to such an extent that riparian proprietors lower down on the same stream will not be deprived of the natural rights accruing from their vested property rights.

If the water in the rivers and lakes of the thickly settled portions of the country were used only for such purposes as the courts and state laws have held as coming within the riparian proprietory rights, it is doubtful whether these sources would furnish a water satisfactory for domestic purposes without some degree of treatment. Even water supplies obtained from protected watersheds located in the hills, mountains, or on the headwaters of streams are often sterilized to guard against accidental pollution.

In considering, therefore, the protection of water supplies by sewage treatment the important problem is not so much as to whether any given water requires purification but rather what effect the presence of sewage in unusual amounts will have on the processes of treatment, and the character of the water produced. The term sewage is used in the broader sense to include all liquid wastes discharged, either from a city's sewers or through outlets from manufacturing plants outside the city limits.

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[3] Stream Pollution; A Digest of Judicial Decisions and a Compilation of Legislation Relating to the Subject. Montgomery and Phelps. U. S. Public Health Bulletin 87.

Using the broader meaning of the word sewage, it becomes apparent at once that a city must consider many factors when deciding whether any given stream that contains a large amount of untreated liquid wastes from other communities is a suitable source for a domestic water supply. These factors will be discussed from the standpoint of the relation they bear to the operation of a purification plant and the quality of water produced.

1. The bacterial content of the water. A stream containing comparatively fresh sewage in large amounts will have large numbers of pathogenic organisms and the potential danger of using such a water, even though filtered and sterilized, may be justification for rejecting the supply or cause for requiring cities or towns upstream to treat their sewage.

2. Color. River or lake waters may contain sewage and colored industrial waste to such an extent that the ordinary purification processes will not remove the color. Dyewastes, tannery, and sulphite wastes from paper manufacturing plants are often discharged into streams in large volumes and the color imparted to the water persists for long distances.

3. Alkalinity. The normal hardness of river water may be so increased by the presence of sewage and industrial wastes that softening processes will be required; or spent acids may be discharged into a river in sufficient amounts to reduce the alkalinity so that, where coagulation is necessary, an additional amount of chemicals will have to be added.

4. Odors and tastes. River water may have pronounced odors and tastes due to the presence of some industrial wastes. Those from gas manufacturing and oil refineries are the most common.

5. Temperature. Industrial establishments located on small streams may use a large part of the stream flow for cooling and other industrial purposes and thereby raise the temperature of the water of the entire stream. The author is familiar with one case where the water at the intake of a filtration plant has a temperature of 137°F. in the summer time.

6. The aesthetic consideration. Floating particles common to sewage, such as pieces of fecal matter, soap, matches, paper, and other miscellaneous material, do not add to the attractiveness of a water as a source for drinking purposes. No matter how efficient filtration may be, public sentiment is against using water from sources in which direct evidences of sewage pollution can be seen, and it is not necessary that such evidence be in the immediate neighborhood of the water intake.

The extent that the influences noted above will have on any particular water supply will depend on local conditions. For example, the sewage and industrial wastes from the Pittsburgh District on the Upper Ohio River do not interfere with the use of the river water at Cincinnati for domestic purposes, and the presence of these wastes does not place an undue burden on the filtration plant. In this particular case, the distance between the two cities on the Ohio River and the dilution are sufficient to permit self-purification to take place.

There are, however, many cities and towns located on streams that would furnish suitable water supplies for domestic purposes if it were not for the fact that the time of flow and dilution of sewage from neighboring communities above are not sufficient for self-purification to take place. In such cases, and there are many of them, sewage treatment should be required, the extent, however, depending upon local conditions. Where the dilution is high but the distance between the point of sewage discharge and water intake is comparatively short, fine screens or some form of tank treatment followed by sterilization may be sufficient. If the dilution and time of flow of sewage discharged into a stream from one city is insufficient to permit self-purification to take place before reaching the water intake of another, complete oxidation in a sewage treatment plant is necessary and in some cases sterilization will be required in addition. Each problem of sewage disposal is, therefore, a special study in itself, and before plans are prepared, a thorough examination should be made to learn what the local requirements are and what design of sewage treatment plant will meet them most satisfactorily.

In water treatment plants it has been possible to adopt standards of purification that are practical and they are being maintained throughout the country. In sewage treatment, however, the purpose is not to maintain a standard which will apply to all plants but rather to so modify the sewage that the natural purifying power of the water in the streams will complete the oxidation of the organic matter remaining in the effluent of the disposal plant. In other words, the effluent from water purification plants must conform to well-defined, uniform standards of quality, while the effluent from sewage treatment plants may be of varying quality, depending on the power of the receiving body of diluting water to bring the purification to the required standard.

The science of sewage treatment has progressed to the point where special processes can be recommended for purifying sewage to any degree required. The type of plant best suited for any given city should be determined, however, by a competent sanitary engineer. Enough money should be available for constructing the plant recommended, and provision should be made for the supervision of its operation. The failure of a large number of sewage disposal plants in operation today to produce satisfactory effluents is due in a very large measure, either to the fact that enough funds were not available to build the treatment plant as large as was recommended by the engineer who designed it, or it has been outgrown, or there is a lack of control over the operation. The mistakes that have been made are not inherent in the principles involved, so that cities wishing to purify their sewage for the protection of water supplies can install and operate properly designed treatment plants with confidence that they will produce the results expected from them.

The question of deciding when one city is discharging more sewage into a stream than its self-purifying powers can take care of before reaching the water intake of another city lower down on the same stream is not always easy to determine. In extreme cases, there will be found, on the one hand, situations where the water at the intake of a city will contain direct evidences of sewage pollution, such as floating material common to sewage, and on the other hand, places where the only evidence of sewage that can be found in the water will be the increased numbers of bacteria and an excess of organic matter. Only a very superficial examination is necessary in the first case to decide whether sewage treatment is necessary for the protection of a water supply, but at the other extreme a very careful survey of the entire situation must be made, including chemical and bacteriological examinations of the water that extend over considerable periods of time.

Formerly when the courts were called upon to decide the relative merits of controversies arising from questions of stream pollution the evidence was, naturally, more or less biased by the purpose for which it was to be used. Even where technical evidence was given, there was a tendency to omit data which might not advance the interests of clients. From the very fact that the parties to such a suit were interested primarily in winning their case and due to the fact that judges and jurymen could not be expected to be familiar with the science of sewage treatment, water purification, and the factors entering into stream pollution, it was not always possible to settle cases on their true merits. There never was, however, any doubt as to the fundamental law regarding the ripiarian proprietory rights, discussed earlier in this paper, but the evidence was lacking in some cases upon which proper interpretation could be made.

A few years ago it became apparent that the courts were not the proper places to decide whether a stream of water had become so badly polluted with sewage that the water was unfit for domestic purposes. It was felt that the greatest use possible should be made of our water-courses in carrying off the liquid wastes from cities and that the authority for deciding when a stream had reached its capacity for carrying sewage should be vested in the state. Accordingly, many states enacted laws for controlling stream pollution and authority for their enforcement has been given to the various state boards of health. For the purpose of carrying out the purpose and intent of these laws, sanitary engineering departments have been developed. These include a chief engineer and assistants, chemists, bacteriologists and laboratory facilities.

It is possible for any state, through such an organization as is referred to above, to keep watch over the streams within its boundaries and to require that they be maintained in a sanitary condition. When controversies do arise over questions of stream pollution, the states should have the means of collecting the important data by experts and presenting the information in an unbiased manner. However, stream pollution cases between individuals and cities ought never to reach the courts in states having a well-organized sanitary engineering department, for the reason that the states should require that corrective measures be applied before conditions reach the point where a law-suit becomes necessary.

The state department of health of every state should have a competent sanitary engineering department with sufficient personnel and equipment to look after the sanitary conditions of all the water-courses within the state. The department will be almost useless, however, if the necessary authority is not given to require that its recommendations be put into effect. The protection of water supplies by enforcement of sewage treatment is a function of the state acting through its department of health, and the extent to which waterways sanitation is enforced will depend upon the laws passed to require sewage treatment, and the personnel and equipment provided to carry out the work.

The states have jurisdiction over the rivers and lakes within their boundaries, but there is no authority at present to require cities located on interstate streams to treat their sewage for the protection of water supplies taken from these streams by cities in other states. The industries along our main waterways are sure to increase in size and number and with them the population will grow apace. The time must come, therefore, when the streams can no longer be utilized, as they are today, for carrying off the raw sewage and wastes from large and thickly settled communities without seriously affecting the use of the water for domestic purposes. The national government alone has the authority to control the pollution of interstate streams, and it would appear to be in the interest of economy as well as the best interests of future generations for the government to guard these streams against excessive pollution that may be difficult and expensive to remove if allowed to progress too far. If laws are passed by the government for the control of sanitation in the interstate streams, they should be closely correlated with the laws of the various states relating to the interstate streams.

The United States Public Health Service, under authority of an Act of Congress passed in August, 1912, has been making a study of the pollution of the interstate rivers, but this law provided only for an investigation of conditions as they exist today. It is believed, however, that the data obtained will eventually be used as a basis for framing the necessary laws for preserving the interstate rivers of our country as a safe source of water supplies for the large cities located on them.